Renewable Energy 4: *What are the predicted costs of new energy generation by type in the future? How would a carbon tax, increased carbon regulation, and the elimination of specialized tax treatment impact those cost estimates?*

Executive Summary

1. A carbon tax or other form of regulation on carbon would be expected to increase costs of fossil-fueled generation.
   a. The Energy Information Administration (EIA) levelized cost estimates for new generation included under Question 3 already reflect a higher cost of capital for coal plants without carbon sequestration. The EIA states this is equivalent to an emissions fee of about $15 per ton of carbon dioxide, as discussed further below. This translates to $16/MWh for new pulverized coal plant and $18/MWh for integrated gasification combined cycle (IGCC).
   b. While the existence and specific amount or form of tax/regulation on carbon are unknown, estimates have been used by various modelers and researchers in the range of $15–$20 per ton, typically with escalation factors to increase the amount over time.

2. The elimination of specialized tax treatment for renewable sources is expected to impact cost of renewable energy sources, namely wind energy, solar, biomass, and landfill gas.

Responses to Renewable Energy Questions 3, 10, and 11 address the current and projected costs of various electric generation sources by type, and should be read in concert with this question related to potential carbon tax and specialized tax treatment for certain types of generation.

1. A carbon tax or other form of regulation on carbon would be expected to increase costs of fossil-fueled generation

The EIA's 2012 and 2013 reference case for estimating the levelized costs of different sources of new generation makes an adjustment for greenhouse gas intensive technologies. Specifically, the EIA increases the cost of capital by 3% for coal-fired power and coal-to-liquids plants without carbon capture and sequestration (CCS). The EIA explains:

> While the 3-percentage point adjustment is somewhat arbitrary, in levelized cost terms its impact is similar to that of an emissions fee of $15 per metric ton of carbon dioxide (CO2) when investing in a new coal plant without CCS, similar to the costs used by utilities and regulators in their resource planning. The adjustment should not be seen as an increase in the actual cost of financing, but rather as representing the implicit hurdle being added to GHG-intensive projects to account for the possibility they may eventually have to purchase allowances or invest in other GHG emission-reducing projects that offset their emissions. As a result, the levelized capital costs of coal-fired plants without CCS are higher than would otherwise be expected.[1]

The EIA clarified that this 3% adder translates to $16/MWh for new pulverized coal plant and $18/MWh for IGCC.[2]

[1] U.S. Energy Information Administration, Levelized Cost of New Generation Resources in the Annual Energy Outlook: 2018 Levelized Costs AEO 2013, January 2013. Available at: http://www.eia.gov/forecasts/aeo/er/pdf/electricity_generation.pdf. See also EIA's 2012 AEO.
[2] Michael Leff, EIA, Personal Communication on March 14, 2013.

Renewable Energy 4: *What are the predicted costs of new energy generation by type in the future? How would a carbon tax, increased carbon regulation, and the elimination of specialized tax treatment impact those cost estimates?*

Recent work on the subject of carbon tax and regulation by the Brookings Institution, Congressional Research Service, MIT, NERA Economic Consulting, and others use a higher estimate in the range of $20 per ton.[3] This would suggest slightly higher levelized cost of energy than the EIA estimates. The February 2013 report from NERA Economic Consulting, "Economic Outcomes of a U.S. Carbon Tax," uses $20 per ton starting in 2013 and increasing 4% per year thereafter. An alternative carbon tax scenario in the study is based on proposed federal legislation that uses the same carbon tax through 2018 ($20/ton with 4% annual escalation), but increases the tax rate thereafter to achieve 80% reduction in carbon dioxide emissions by the end of 2053 (with an overall cap of $1,000 per ton). The EIA has also modeled scenarios of $25 per ton in 2013, and increasing 5% per year through 2035. Sensitivities with different values for carbon and other assumptions can be run as part of utility planning processes.

A carbon tax could not only affect the cost and type of new electric generation, but also the cost and combination of the existing fleet of generation. Exhibit 1 includes the NERA study estimates of the impact of the two carbon tax scenarios on the overall cost of electricity in the U.S.

EXHIBIT 1. Residential Delivered Electricity Prices (2012¢/kWh)

	2013	2023	2033	2043	2053
Baseline	12.0¢	13.7¢	14.3¢	16.0¢	17.1¢
$20 Tax Case	13.4¢	15.4¢	16.7¢	19.3¢	20.5¢
Percentage change from baseline	**12%**	**12%**	**16%**	**21%**	**20%**
80% Reduction Tax Case	13.5¢	16.2¢	18.6¢	25.9¢	24.3¢
Percentage change from baseline	**13%**	**18%**	**30%**	**61%**	**42%**

SOURCE: NERA Economic Consulting, Economic Outcomes of a U.S. Carbon Tax, Prepared for National Association of Manufacturers, February 26, 2013, p. 33.
Available at: www.nam.org/~/media/64FDD87B13C44C3E8E95CC805E4E5952.ashx.

2. The elimination of specialized tax treatment for renewable sources is expected to impact cost of renewable energy sources, namely wind energy, solar, biomass, and landfill gas.

There are several forms of specialized tax treatment for qualifying renewable energy sources that are in service by specific dates (e.g., 2013 for wind, 2016 for solar). The federal production tax credit (PTC) for wind energy, which would apply to projects in operation by the end of 2013, lowers the levelized cost by 14–46% depending on the facility's capacity factor and other assumptions. Tax credits are also available for biomass, landfill gas, and geothermal. Solar thermal and PV are eligible to receive a 30% investment tax credit on capital expenditures if placed in service before the end of 2016; the credit is reduced to 10% for projects installed after 2016.

[3] NERA Economic Consulting, Economic Outcomes of a U.S. Carbon Tax, Prepared for National Association of Manufacturers, February 17, 2013, citing J.L. Ramseur, J.A. Leggett and M.F. Sherlock, Carbon Tax: Deficit Reduction and Other Considerations, Congressional Research Service report for Congress #7-5700, September 17, 2012; M. Muro and J. Rothwell, "Cut to Invest: Institute a Modest Carbon Tax to Reduce Carbon Emissions, Finance Clean Energy Technology Development, Cut Taxes, and Reduce the Deficit"; Remaking Federalism/Renewing the Economy #7, Brookings, November 13, 2012. S. Rausch and J. Reilly, Carbon Tax Revenue and the Budget Deficit: A Win-Win-Win Solution? MIT Joint Program on the Science and Policy of Global Change, Report # 228, August 2012; W. McKibbin, A. Morris, P. Wilcoxen, and Y. Cai, The Potential Role of a Carbon Tax in U.S. Fiscal Reform, Climate and Energy Economics Discussion Paper, Brookings, July 24, 2012. See NERA report at: www.nam.org/~/media/64FDD87B13C44C3E8E95CC805E4E5952.ashx

Renewable Energy 4: *What are the predicted costs of new energy generation by type in the future? How would a carbon tax, increased carbon regulation, and the elimination of specialized tax treatment impact those cost estimates?*

Exhibit 2 below shows the EIA's 2012 published levelized cost of energy estimates for new utility-scale renewable generation with an in-service date of 2017. These EIA estimates do *not* reflect the PTC or other tax incentives. Therefore, the table also shows the tax incentive, in dollars per megawatt-hour, for the applicable renewable technology to illustrate the impact on the overall cost (although the incentive will not be available with a 2017 in-service date). The adjusted EIA estimate *with* the tax incentive is shown in the last column. The tax incentive would lower the levelized cost of energy. For example, for wind energy, it reduces the cost by about a third. This reduction is consistent with the recent wind contract prices in Michigan that incorporate these tax incentives since the projects had in-service dates before the 2013 PTC deadline. This topic is discussed in more detail under Renewable Energy Questions 3 and 21.

EXHIBIT 2. Renewable Energy Tax Incentives in $/MWh

	Published 2012 EIA Levelized Cost of Energy Estimate—$/MWh (2017 In-service Date with No Tax Incentive)	**Tax Incentive** ($/MWh)	**Adjusted EIA Levelized Cost of Energy Estimate** (with Tax Incentive)
Wind	$96.00	($29.20)	$66.80
Biomass	$115.40	($14.60)	$100.80
Solar PV	$152.70	($36.00)	$116.70

SOURCE: EIA, Annual Energy Outlook 2012, Levelized Cost of New Generation Resources in the Annual Energy Outlook 2012 (July 12, 2012); Lazard's Levelized Cost of Energy Analysis, Version 6.0 (June 2012).
NOTE: The $/MWh amounts for the tax incentive are based on the current PTCs of $22/MWh for wind energy and $11/MWh for biomass and landfill gas and are adjusted for inflation, levelized, and grossed up for taxes. The solar tax incentive is based on Lazard's analysis of the subsidized and unsubsidized levelized cost of energy for two different utility-scale solar PV technologies: crystalline and thin film. The subsidized amount is based on the 30% investment tax credit for solar. Since the EIA levelized cost estimates are utility-scale only, the rooftop solar PV estimates in Lazard's analysis are not shown in the table. The subsidy for this technology is about $52/MWh (reducing levelized cost of energy for high-range estimate from $204/MWh to $152/MWh).